Measuring innovation in all sectors of the economy

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Measuring Innovation in All Sectors of the Economy

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Abstract
This paper reviews the history of measurement of innovation using definitions in three editions of the Oslo Manual. It then draws on work on innovation in the public sector and innovation by households to generalise the Oslo Manual definitions for application in all sectors of the economy, as defined in the 2008 Manual for the System of National Accounts. The generalised, or meta-definitions are then discussed in the context of each sector and linked to current literature. Finally, the role of measurement in policy learning is considered as well as the importance of innovation indicators for the development, monitoring and evaluation of innovation policy across the economy.

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Key words
Innovation indicators, definitions of innovation, system of national accounts, policy learning, statistical measurement

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1. Introduction

"Innovation drives growth and helps address social challenges" (OECD 2010a). Innovation mitigates climate change, advances sustainable development, and promotes social cohesion. There are many claims for what innovation does, but to support these claims, to inform policy development, and to evaluate policy implementation, innovation has to be measured. This paper is about measuring innovation, how that measurement is broadening, how the resulting indicators are changing and how this has implications for policy.

1.1. Defining and measuring innovation, a historical perspective

Before innovation can be measured, it must be defined for statistical purposes. There has been a formal definition since 1992, but, unlike the definition of research and experimental development (OECD 2015a) which has been around twice as long, the definition of innovation for statistical purposes has changed.

Oslo Manual first edition

The definition of innovation grew out of experimental innovation surveys of the 70s and 80s leading to the first codification of how to define innovation for measurement purposes in the first Oslo Manual (OECD 1992). That manual was limited mainly to manufacturing, although services were mentioned (OECD 1992: para. 239) and it involved only technological product and process innovation. The process was the production of a product. The first edition of the Oslo Manual was partially implemented through the first European Community Innovation Survey (CIS) conducted for reference year 1992.

Oslo Manual second edition

After five years the manual was revised (OECD/Eurostat 1997) to include services, which dominated GDP, then as now, but it was still about technological product and process innovation, and putting of product on the market. Process innovation included production, but added delivery of the resulting product to the market. Many things happened in the five years between the first and the second editions of the Oslo Manual that were to have impact on it and on later editions. The System of National Accounts (SNA) was revised (EC et al. 1994) and expenditure on software became a capital investment, rather than an expense. In addition, the language and the approach of the SNA influenced the discourse around innovation. The OECD Blue Sky Forum of 1996 (OECD 2001) saw more discussion of a systems approach to understanding innovation. This was rooted in the work in National Systems of Innovation developed by Freeman (1987), Lundvall (1992) and Nelson (1993) but it also went back to Simon (1996[1]), and Forrester (1971, 1982) and a basic view of the systems approach as an analytical tool. Another significant change was that the Oslo Manual became a joint product of Eurostat, the statistical office of the European Commission, and the OECD. This

[1] This citation is to the third edition. *Sciences of the Artificial* was first published in 1969.

reflected the place of the manual as the source of the concepts and definitions used in the Community Innovation Survey. The second edition of the Oslo Manual continued to guide the CIS.

Oslo Manual third edition

In parallel with the discussion about measuring innovation, there was a growing interest in organisational change and the use of business practices in the context of knowledge management (Nonaka and Takeuchi 1995). This led to an OECD project where participating countries conducted surveys of the use of knowledge management practices, shared their findings, and produced a model questionnaire (OECD 2003). A finding of this work was that business practices could be treated as a technology using the same measurement techniques as had been applied to surveys of the use of manufacturing technologies. This had implications for the third edition of the Oslo Manual.

Another influence on the third edition was the appearance of the Bogotá Manual (RICYT/OEC/CYTED 2001) which provided guidance on measuring innovation in manufacturing in Latin America and the Caribbean. RICYT also initiated a proposal to have an Annex to the third edition of the Oslo Manual to interpret the manual for use in developing countries. This was agreed, coordinated by the UNESCO Institute of Statistics, and formed part of the manual (OECD/Eurostat 2005: 135).

The revision leading to the third edition of the Oslo Manual (OECD/Eurostat 2005) took place in 2003 to 2005. Products were still goods or services, but to process innovation (production or delivery of product) were added two methods, organisation and use of business practices, and market development or the finding of new markets. The result was one process, two methods, and one product to be delivered to the market. Reflecting the influence of service industries, the qualifier, 'technological', was dropped from the title and to align with an EC directive for the CIS, the guidelines were no longer 'proposed', they were guidelines to be followed. Innovation remained a market phenomenon but, during the decade that followed, questions were raised about whether the market restriction should be revised to include other sectors of economy such as General government, Non-profit institutions serving households (NPISHs) and Households[2].

1.2. Broadening the definition of innovation

To support a broader definition of innovation, there are longstanding discussions about innovation in public institutions (Bloch 2013) and in households (de Jong and von Hippel 2013) but neither have led to the equivalent of the Oslo Manual to guide the

[2] These sectors are taken from the System of National Accounts 2008 manual (EC et al. 2009). For R&D statistics, the Frascati Manual (OECD 2015) uses sectors which are close to those in the SNA, with the exception of the Higher education sector which is unique to the Frascati Manual. In this paper, SNA sectors are used. The only difference is that the 'Business enterprise sector' is used to represent the SNA Non-financial corporations sector and the Financial corporations sector. The Public Sector is the General government sector and public corporations (EC et al. 2009: para. 22.41).

measurement of the activity and the interpretation of the findings. However these discussions could have impact on the third revision of the Oslo Manual which began in 2015, with implications for official statistics on innovation and for the monitoring and evaluation of the implantation of innovation policy.

In addition to these ongoing discussions following the second revision of the Oslo Manual, the second OECD Blue Sky Forum took place in 2006 (OECD 2007) in order to consider:

- new uses of existing science, technology and innovation (STI) indicators;
- new uses of existing non-STI indicators for the purpose of STI policy making;
- completely new STI indicators; and
- a synthesis of findings leading to an agenda for the next decade of work on STI indicators.

In the book that followed, (OECD 2007), there were chapters on user innovation (von Hippel 2007: 125), on innovation and sustainable development (Bordt et al. 2007: 251), and a warning by Chris Freeman and Luc Soete (2007: 271) about how existing indicators could be misleading, a point also discussed in the US context by John Marburger (2007: 27).

1.3. Issues for the third revision of the Oslo Manual

In 2010 the OECD released its Innovation Strategy (OECD 2010a) and a related programme of measurement (OECD 2010b). More recently, the Innovation Strategy has been updated (OECD 2015b). The strategy and the measurement programme have implications for the third revision of the Oslo Manual and the third OECD Blue Sky Forum is scheduled for September 2016 which will provide more input.

The aim of this paper is to review the definition of innovation for measurement purposes, and its implementation, in order to consider options for moving from innovation in the Business enterprise sector to innovation in all SNA sectors. While the resulting generalised or meta-definitions would be applicable in all sectors, they would have to be rephrased for application in each sector to reflect the different contexts. For the third revision of the Oslo Manual, this suggests that the first step would be to agree upon the meta-definitions and then to revise them for use in the Business enterprise sector. As other manuals were developed for the Household sector, the NPISH sector and the Public Sector, the same meta-definitions would be adjusted to fit each sector. This paper proposes the meta-definitions for discussion.

The first step is to examine the current definitions of innovation in Section 2 and then to look at how they might be generalised in Section 3. Section 4 discusses the application of the generalised definitions to the SNA sectors. Section 5 looks at policy implications and what is required for policy learning, development, monitoring and evaluation. Section 6 concludes.

2. The definition of innovation for measurement purposes in the third edition of the Oslo Manual and its characteristics

2.1. The Oslo Manual Definition

The definition of innovation follows and it includes the paragraph numbers from OECD/Eurostat (2005).

> 146. An *innovation* is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.

The definition is linked to the market through `implementation` which is explained in paragraph 150.

> 150. A common feature of an innovation is that it must have been *implemented*. A new or improved product is implemented when it is introduced on the market. New processes, marketing methods or organisational methods are implemented when they are brought into actual use in the firm's operations.

An innovative firm is defined as follows[3].

> 152. An *innovative firm* is one that has implemented an innovation during the period under review.

In principle, paragraph 146 could apply to an institution in any sector of the economy, depending on the interpretation of the word 'marketing'. It is only when implementation is defined in paragraph150 that the definition of innovation, which is made up of both paragraphs 146 and 150, applies only to the Business enterprise sector. There are three indications of this: (product) "when it is introduced on the market"; (process/method) "when they are brought into the firm's operations" (both in paragraph 150); and (process/method) "marketing method" (paragraph 146) or "methods" (paragraph 150).
The references to the firm and the market are consistent with the scope of the Oslo Manual. Paragraph 26 is very clear that the manual applies only to the Business enterprise sector, deals with innovation at the level of the firm, covers four types of innovation, and the lowest level of novelty to qualify as an innovation is 'new to the firm'.

[3] For international comparison, such as in the Scoreboards of the European Union, the statistic used is the innovation-active firm which is defined in OECD/Eurostat (2005: paragraph 215): An **innovation-active firm** is one that has had innovation activities during the period under review, including those that were ongoing or abandoned activities. This is a much weaker requirement than that for an innovative firm. Innovation activities are defined in paragraph 149, but see also paragraph 103.

The manual does say in paragraph 27 that innovation could occur in any sector of the economy and goes on to suggest that there is a place for a separate manual on innovation in the public sector, an option that will be considered in the next section.

2.2. Normative characteristics of the definition

Before moving on, note that the definition in paragraphs 146 and 150 is not explicitly normative; the definition covers innovation which can be good or bad, pro-poor or anti-poor, sustainable or not. It only requires that the product be introduced on the market or that the process or methods provide better[4] ways of getting product to market. Attempts have been made to impose normative conditions on the definition, but they are not present in the Oslo Manual.

The use of the word "improved" in the definition has been used to challenge the statement about the definition not being normative and the word 'changed' has been used in Australian surveys to avoid this (Arundel and Huber 2013). 'Change' can have both positive and negative outcomes but so can 'improved' as, in the Business enterprise sector, it reflects the strategy of the business which governs the implementation of products or processes. However, to avoid having to make the connection to the strategy of the institutional unit, whatever sector it is in, 'changed' will be used in preference to 'improved' in the generalised definition in Section 3. The objective is to have a definition of innovation that is behavioural and which can be detected by responses to survey questions about what the institutional unit actually did in the reference period. For example, did the institutional unit introduce new or significantly changed products on to the market in the reference period? Or, did the institutional unit implement a new or significantly changed process or method in the reference period? The responses then permit an inference about whether there has been innovation on the part of the institutional unit or not. This, and the wording of the survey questions, is discussed further in Section 4.

2.3. Restrictions imposed upon the definition

As noted in Section 1, innovation is expected to result in desirable economic and social outcomes. With this in mind, the definition of innovation can have restrictions imposed upon it. An example is the adding of a qualifier, such as 'inclusive' and an expectation or intention, such as 'for sustainable development', resulting in 'inclusive innovation for sustainable development' (Gault 2014, Mashalkar 2012). Restriction has measurement implications discussed in Gault (2014) which will be considered briefly in Section 5 as such restrictions can be applied to any version of the definition and they have policy implications. The real question is how the expected behaviour is detected through statistical measurement.

[4] The word 'better' has normative connotations. Subsequent references to a process or method getting a product to market will use the words 'changed' or 'different'. In a business enterprise such changes might not be environmentally better, or socially better, but they are changes made to implement a business strategy.

2.4. Implementing the definition of innovation

For a definition to be useful, it has to be implemented. The CIS has provided a partial implementation of the Oslo Manual definition since 1992 and the 2005 definition has provided guidance to CIS following 2005, including CIS 2014. There is a substantial and growing experience of working with the CIS in EU countries and in others, some of which is discussed by Arundel and Smith (2013). However, the same guidance and the experience of a community of practice resulting from the production of official statistics are not present when it comes to innovation in the General government sector, the NPISH sector or the Household sector. A first step is to consider how to generalise the definition of innovation to accommodate all sectors of the SNA and then to consider how that definition could be implemented.

3. Generalising the definition of innovation

This section examines the definitions of innovation found in the third edition of the Oslo Manual and in work on public sector innovation and arrives at a set of definitions that could be applied to both the Business enterprise sector and to the General government sector and government institutions in the Financial and Non-financial corporations sectors (The Public sector). The section could also have included a discussion of the Household and the NPISH sectors but these are left to Section 4. The reason for this is that there is no comparable body of work on definitions of innovation in either of these sectors. The section starts with a discussion of the terms in the Oslo Manual definition which tie the definition of innovation to the Business enterprise sector and then they are replaced with more general terms, leading to the generalised or meta-definitions of innovation. The section continues with the definitions of marketing/communication innovation, organisational innovation, then 'process' innovation before suggesting that all three be considered components of process innovation. The order is deliberate as it moves towards more elaborate decisions concerning process innovation and then product innovation before proposing generalised or meta-definitions of innovation.

3.1. Firm, market and marketing

The observation has already been made that the terms 'firm', 'market' and 'marketing' in the existing definition limit its domain of application to the Business enterprise sector. To generalise the definition 'firm' can be replaced by 'institutional unit'. The SNA 2008 Manual notes there are two classes of institutional units, persons or groups of persons in the form of households, and legal or social entities (EC et al. 2009: 61). Institutional units are present in all SNA sectors so this is a first step towards generalisation.

'Market' is another issue. In an earlier work, the suggestion was made that "introduced on the market" in paragraph 146 could be replaced by 'made available to potential users' (Gault 2012). This preserves the requirement that, for a product to be an innovation, it must be made available by some means, otherwise it may be an invention

but it is not an innovation. The motivation for the proposal came from work on user innovation in Finland (de Jong et al. 2015, Kuusistso et al. 2013) and what was being measured there was the modification of products by households or individual consumers, or the development of new products if they were not available on the market. The change proposed in Gault (2012) allowed the households or individuals to be classified as innovators if they made their new or significantly improved products available to potential users and a reference to the approach applied to individuals can be found in Hienerth et al. (2014). The modification to the definition was also applicable to public institutions and that is discussed in Gault (2012) and in Bloch and Bugge (2013). Given the focus on product innovation, Gault (2012) did not address processes, except to note that processes help move products, innovations or existing products, through the firm to the market.

The 2005 Oslo Manual definition requires that "New processes, marketing methods or organisational methods are implemented when they are brought into actual use in the firm's operations". There is a question about whether processes and methods in the present definition are indeed connected to the market. For firms that are putting product on the market, the purpose of the underlying processes, or methods, is to get it there in different ways. However there are firms that exist for years with no market connection. Consider a start-up firm that is producing a new medical product. It can spend a decade developing the product, which is certainly new or significantly improved but which cannot be 'introduced on the market' until all stages of clinical trials are completed successfully. Only then is the firm an innovative firm and only then can the processes or methods, if they are new or significantly improved, be considered innovative. This is also a good example of innovation activities (OECD/Eurostat 2005: 35) not being synonymous with the activity of innovation. Such a firm could spend a significant amount on the performance of research and development, on capital expenditure, and training of staff, all innovation activities, but without the link to the market for the product, the firm is not innovative and neither are the processes or methods used in the firm. However, the firm data would appear in innovation scoreboards as the firm would have ongoing or abandoned innovation activities and would be 'innovation-active' (OECD/Eurostat: para. 215).

The question that remains is whether, in a generalised definition, the link to what replaces the market remains for the processes. Before returning to that question, there is the matter of marketing method and how to generalise it.

3.2. Marketing/Communication innovation

Marketing, in the third edition of the Oslo Manual, deals with 'a new marketing method' which is discussed in OECD/Eurostat (2005: para. 169-176). This could be a new approach to an existing market or a means of opening a new market. The term 'market' suggests that transactions are at 'economically significant prices' (EC et al. 2009, para. 22.28).

Bloch (2013) and Bloch and Bugge (2013) have reviewed the literature on measuring innovation in the public sector and discussed the definitions of innovation, product innovation, process innovation, organisational innovation, and communication innovation used in the Measuring Public Innovation in Nordic (MEPIN) Countries project (Bloch 2010a, 2010b, Bugge et al. 2011, 2010). The definitions[5] are not far from those used in the third edition of the Oslo Manual, with the exception of the use of communication innovation in the place of marketing innovation. The MEPIN definition of communication innovation used is the following.

> A *communication innovation* is the implementation of a new method of promoting the organisation or its services and goods, or new methods to influence the behaviour of individuals or others. These must differ significantly from existing communication methods in your organisation (Bloch and Bugge 2013: 143).

This can be compared with the Oslo Manual definition of marketing innovation.

> A *marketing innovation* is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing (OECD/Eurostat 2005: para. 169).

Both 'marketing' and 'communication' are means of persuading potential users in an existing population of institutions or households (markets), or in new populations of institutions or households (markets), to use the products of the institutional unit. While 'communication' is a more general term than 'marketing', the suggestion is that 'marketing' be used in the generalised definition. The reason for this is that it might be easier to understand 'marketing' in sectors other than Business enterprise and then to retain it in the sector definition or to use another term, such as 'communication'. The generalised or meta-definition follows.

> A *marketing innovation* is the implementation of a new or significantly changed method of promoting products of the institutional unit.

This generalised definition of innovation related to product promotion addresses two other issues: 'improved' is replaced by 'changed'; and 'significantly changed' has been added to the definition.

In the 2005 Oslo Manual, the definitions of product innovation and the process of production or delivery innovation use the phrase 'or significantly improved' but the definitions of organisational innovation and marketing innovation use only 'new' but not 'or significantly improved'. This has been added in the generalised definition of marketing innovation above. This definition can be applied directly in the Business

[5] These definitions were developed and tested through pilot surveys in each of the Nordic countries, conducted by Statistics Denmark, Statistics Norway, Statistics Sweden, Statistics Finland and RANNIS.

enterprise sector and the methods of promoting products can be qualified to include design, packaging or placement, pricing and promotion.

Marketing innovation crosses the boundary of the institutional unit to make potential users aware of the product. The organisational innovation (Section 3.3) and process innovation (Section 3.4) include both internal and boundary crossing activities of the institutional unit.

3.3. Organisational innovation

The definition of organisational innovation in the 2005 Oslo Manual is the following.

> An *organisational innovation* is the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations (OECD/Eurostat 2005: para. 177).

This definition is meant for the Business enterprise sector as it refers to 'the firm's business practices'. The Oslo Manual, as noted, deals only with a 'new organisational method …', not a new or significantly improved method as is the case for the definition of product innovation or the production or delivery process. Implementation is defined in paragraph 150 of the Oslo Manual. The definition is elaborated upon in paragraphs 178 to 184.

The definition used in the MEPIN project is the following.

> An *organisational* innovation is the implementation of a new method for organising or managing work that differs significantly from existing methods in your organisation. This includes new or significant improvements to management systems or workplace organisation (Bloch and Bugge 2013: 143).

This definition is not far removed from the Oslo Manual definition and it includes 'significant improvements' as well as new organisational methods. What is not defined in Bloch and Bugge is 'implementation' which may be, implicitly, referring back to the Oslo Manual definition.

The definition can be generalised as follows.

> An *organisational innovation* is the implementation of a new or significantly changed organisational method in workplace organisation or external relations of the institutional unit.

As with other process innovations, it would have to be elaborated upon for application in a particular sector. However, 'implementation' would be defined as it is in Section 3.6.

3.4. Process innovation

In the 2005 Oslo Manual defines 'process innovation' as follows.

> A *process innovation* is the implementation of a new or significantly improved production or delivery methods. This includes significant changes in techniques, equipment and/or software (OECD/Eurostat 2005: para. 163).

The definition is elaborated for use in the Business enterprise sector in paragraphs 164 to 168 of OECD/Eurostat (2005).

This can be compared with the MEPIN definition.

> A *process innovation* is the implementation of a method for the production and provision of services and goods, that is new or significantly improved compared to existing processes in your organisation. This may involve significant improvements in for example, equipment and/or skills. This also includes significant improvements in support functions such as IT, accounting and purchasing (Bloch and Bugge 2013: 143).

There are differences in the definitions. Production, whether dealing with goods or services, has to do with combining inputs to produce outputs. Then there is the activity of delivering the outputs (products) to the market (potential users) which may be independent of the production or an integral part of it. The innovation can be in either or both and it can also involve organisational or marketing activities. In the MEPIN definition production and provision are tied together. This is not the case in the Oslo Manual definition. The elaboration of the MEPIN definition includes supporting functions that could also be placed in organisational innovation.

The use of 'method' in the MEPIN definition raises another question. In the 2005 Oslo Manual, there are four types of innovation, product, process, and two 'methods', organisation and marketing. The use of process goes back to technological processes in the first Oslo Manual and is related to production and later to delivery of a product. The question is whether the process and the two methods could all be considered methods or processes, or components of a 'process' or 'method'.

'Production' is a matter of converting inputs to outputs, at least one of which is a product and it could be referred to as a transformation process[6]. However, for the purpose of proposing a generalised or meta-definition, the word 'production' will be used, rather than any term that emphasises transformation. Given that there are two other processes or methods, 'production and delivery' qualified by 'process' will be used.

[6] Transformation of inputs to outputs, one of which is a product, has been considered in the literature where engineering and economic perspectives overlap (Gault et al. 1985). While this is of interest from a systems perspective, it is not central to a discussion of a meta-definition.

The definition can be generalised as follows.

> *A production or delivery innovation* is the implementation of a new or significantly changed production or delivery method. This includes significant changes in inputs, infrastructure within the institutional unit, and techniques.

This makes clear that production or delivery (of the resulting products), constitute one of three processes to be considered in defining and measuring innovation. The second sentence is changed to emphasise inputs, and to avoid being specific in what is present in the infrastructure of the institutional unit. That can be elaborated upon for each of the sectors where measurement of innovation is to take place.

3.5. Processes or process?

It is clear from the discussion on Sections 3.2, 3.3 and 3.4 that processes (or methods) overlap. Rather than having one product, one process and two methods in the definitions of innovation, the suggestion is to have either three processes or one process with three components. The recommendation is to have one process with three components.

The advantage of working with one process would have little impact on the implementation of the definitions in surveys such as the CIS, as the same data could be gathered and an aggregate reported for process innovation and then broken down by three sub-categories: production and delivery; organisation; and marketing. This would preserve the data series for production and delivery innovation.

3.6. Product innovation

The Oslo Manual definition of product innovation is the following.

> *A product innovation* is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in the technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics (OECD/Eurostat 2005: para. 156).

The definition is elaborated for use in the Business enterprise sector in OECD/Eurostat (2005: paras 157 – 162).

The MEPIN definition is the following.

> A product innovation is the introduction of a service or good that is new or significantly improved compared to existing services or goods in your organisation. This includes significant improvements in the service or good's characteristics, in customer access or in how it is used (Bloch and Bugge 2013: 143).

Both definitions begin with the "introduction of a", but 'introduction' is not defined in either definition. In the case of the Oslo Manual definition, 'introduced' appears in paragraph 150 in the sentence, "A new or improved product is implemented when it is introduced on the market". The implicit assumption is that, in the Oslo Manual, 'introduced' means introduced on the market, but this is not obviously the case for the MEPIN definition. It is also of interest that the sentence in paragraph 150 does not include the word 'significantly' to modify 'improved' while 'significantly improved' is used in paragraph 146. In the generalised definition, 'introduce' is dropped in favour of 'made available to potential users'.

Both definitions include a qualifying sentence which could appear in text elaborating the definition rather than as part of the definition. These qualifying sentences could be omitted in a generalised definition as the qualification for application in each SNA sector will be different. The following generalised definition of product innovation is suggested.

> A *product innovation* is a product, made available to potential users, that is new or significantly changed with respect to its characteristics or intended uses.

3.7. A generalised definition of innovation

The previous sections have reviewed the definitions used in the third edition of the Oslo Manual for innovation in the Business enterprise sector and MEPIN projects definitions for innovation in the Public sector. In the course of this, three components of an innovation process have been identified, as well as one product, which can qualify as innovations. In the generalised definitions of the processes and the product, 'changed' has replaced 'improved' to remove or reduce the normative nature of the definition and 'product' is used in place of good or service, to align with SNA language. This is continued in the generalised definition of innovation which follows. It replaces paragraphs 146 and 150 of the third edition of the Oslo Manual.

> An *innovation* is the implementation of a new or significantly changed product or process. A product is a good or a service. Process includes production or delivery, organisation, or marketing processes.
>
> A new or significantly changed product is *implemented* when it is made available to potential users. New or significantly changed processes are implemented when they are brought into actual use in the operation of the institutional unit.

A final point on the generalised or meta-definitions provided in this section is that they should never be used, unchanged, in innovation surveys. Surveys are contextual and the language used in surveys should preserve the intent of the meta-definitions but also be understood by the respondent. That understanding should be confirmed by cognitive testing of the survey instrument. As an interim step, once meta-definitions are agreed, the wording for each sector application should be agreed as the relevant manuals are

developed and from these definitions, the language used in surveys or structured interviews should be developed.

4. Sectors, measurement and dissemination

Measurement of the activity of innovation in the whole economy requires the generalised definitions of innovations, products and processes that were discussed in the previous section. For these definitions to be applied in the SNA sectors to support data gathering through surveys or administrative sources, they have to be interpreted for these purposes. The third edition of the Oslo Manual provides elaboration of each of the definitions for application in the Business enterprise sector (which covers both the SNA Financial and Non-financial sectors). In what follows, there is a discussion of the application of the generalised definitions in each SNA sector. This leaves open the question as to whether the fourth edition of the Oslo Manual should deal with all SNA sectors or remain dedicated to the Business enterprise sector. If the latter, there is the option of agreeing upon a standard set of generalised or meta-definitions and showing that the definitions used in the fourth edition of the manual are special cases of the generalised or meta-definition. If this path is followed, there is then the option of developing separate manuals and interpreting the meta-definitions in each sector. The possibility of a manual for Public sector innovation has already been raised in paragraph 28 of the third edition of the Oslo Manual.

In the sections following, the definitions are discussed in the context of the SNA sectors, with some comments on measurement and dissemination tools. All of the generalised definitions are listed in an Annex. To align with past practice the Business enterprise sector includes the Financial and Non-financial sectors of the SNA and the Public sector includes the General government sector and public financial and non-financial corporations (EC et al. 2009: para. 22.39).

4.1. Business enterprise sector (Corporations sectors)

For the Business enterprise sector, the institutional unit is the enterprise. The practice in previous editions of the Oslo Manual is to use the term ‘firm’ rather than ‘enterprise’. The definition of innovation (Section 3.6 or the Annex) requires that a product be made available to potential users and that a process be brought into actual use in the institutional unit (the firm).

For the product, making it available to potential users could be interpreted as introducing it on the market and there is then no change. However, there is another possibility to consider as the product could be made available to potential users at no cost. The example is Linux software products which the firm could make available to the Linux community. If this option is adopted, Business enterprise innovation statistics could be classified as market (sold at economically significant prices) and non-market product innovation.

For process innovation, the three component processes used in the Oslo Manual are close to those in Section 3 and the Annex.

The Oslo Manual provided the concepts and definitions used in the EU Community Innovation Survey (CIS). This is illustrated by the question on product innovation:

During the three years 2012 to 2014, did your enterprise introduce:

New or significantly improved goods (exclude the simple resale of new goods and changes of a solely aesthetic nature)	Yes/No
New or significantly improved services	Yes/No

The term ‘introduce’ is not defined for the respondent and neither is the term ‘implemented’ defined when it is used in the introduction to the question on process innovation (production or delivery innovation).

Innovation surveys are business surveys, ideally with their sample drawn from a business register leading to population estimates for variables in the survey provided for industries in the Business enterprise sector. Business survey methodology is well established in most countries and is reviewed in the Oslo Manual.

Results of the surveys such as the CIS, are presented in country reports and in international scoreboards such as the Innovation Union Scoreboard (EC 2015) in Europe, the African Innovation Outlook in Africa (AU/NEPAD 2014), and the RICYT publications for Latin America and the Caribbean.

4.2. Public sector

The Public sector consists of the General government sector and the aggregate of all public corporations. Public corporations can be further divided into non-financial corporations and financial corporations other than the central bank.

Public sector institutions produce products and can make them available to potential users at no cost or at economically significant prices. The bulk of these products are services provided to potential users and the generalised definition for product innovation can be applied directly. As with the Business enterprise sector, innovation by Public sector institutional units could be reported for product innovations provided at no cost and product innovations provided at an economically significant price.

This paper has drawn upon the work on Public sector innovation measurement in the MEPIN project, but, as pointed out in Bloch and Bugge (2013), there is no equivalent to the CIS for the Public sector and there is no equivalent to the Oslo Manual. There is no reason why there cannot be a manual devoted to innovation in the Public sector which follows a standard set of definitions, as suggested in the 2005 Oslo Manual.

Surveying institutional units in the Public sector has challenges unless there is a statistical register of such units. In some countries there is not. However there is the European Public sector innovation scoreboard (EPSIS), discussed by Bloch and Bugge (2013) and earlier work published in the EC Innobarometer 2010. There is the Observatory of Public Sector Innovation (OPSI) at the OECD which collects examples of innovation but not following any particular definition. As well as providing examples of innovation in the Public sector through an on-line platform, OPSI is also a network of practitioners and a source of guidance based on case studies (https://www.oecd.org/governance/observatory-public-sector-innovation.htm).
The focus of this paper is on the activity of innovation in institutional units in SNA sectors, in this case the Public sector. It does not address the role of the sectors in facilitating or promoting innovation in other sectors, unless that is done through the making available of new or significantly changed products to potential users.

4.3. Non-Profit institutions serving households (NPISHs) sector[7]

To paraphrase the SNA Manual (EC et al. 2009, para. 4.166), Non-Profit Institutions (NPIs) are allocated to the Corporations sectors when they are engaged in market production and to the General government sector if they are engaged in non-market production but subject to government control. The rest are NPISHs. All provide goods and services free or at prices that are not economically significant.

There are three types of NPISHs, member organisation, charities, and those providing collective services such as research organisations that make their results freely available and environmental groups. From the perspective of measuring innovation in the NPISHs sector, the same approach could be used as for the Public sector.

4.4. The Household sector

The Household sector can include a number of activities (EC et al. 2009: para. 4.155). The households are distinguished from corporations in that they undertake final consumption, but like corporations, they can engage in production. Household unincorporated market enterprises can produce goods and services for sale or barter on the market and for the purpose of measuring innovation activities; these enterprises can be treated like institutions in the Business enterprise sector. Household unincorporated market enterprises can include partnerships, but large legal, accounting or architectural firms are treated as quasi-corporations.

As there are many activities in the sector, the measurement of innovation requires some judgement. Households, including individuals selling on the market at economically significant prices should be treated in the same way as institutional units in the Business enterprise sector. Those households and individuals, that change goods or services for their own benefit, or develop goods or services which are not available to them, should

[7] The use of the SNA NPISH sector differs from the Private-non profit (PNP) sector in the Frascati Manual (OECD 2015: Chapter 3). There, the PNP sector includes NPISHs, that are not part of the Frascati Higher education sector and it also includes the Household sector.

be treated as if they were in the Business enterprise sector if they sell the resulting goods at economically significant prices. However, if they make the products, or knowledge about how to produce the products available at no cost, they can be treated in the same way as institutional units in the public sector. The question then is how the product is made available to potential users (Gault 2012). If the products are not sold or otherwise made available to potential users there is no activity of innovation. The literature in this area has been reviewed by de Jong and von Hippel (2013).

Measurement of innovation in the Household sector may involve social as well as business surveys and especially for households or individuals that modify or develop goods or services for their own benefit. There is no equivalent to the European Public sector innovation scoreboard or the European Innovation Union scoreboard. What is available is a large number of case studies in various countries studying innovative activities of households or individuals leading to a body of knowledge about changing or developing products and making them available to potential users. Examples are found in de Jong et al. (2015).

4.5. Rest of the world (ROW) sector

There is a fifth SNA sector, the Rest of the world sector. This sector is not relevant for innovation measurement as the measurement is made for institutional units resident in a country. Institutional units in any sector may import goods or services that then form part of their production activities and if the result is ‘new to the institutional unit’, it is an innovation. However the measurement task is to identify this in the resident institutional unit.

5. Policy development, monitoring, evaluation and learning

Innovation, to paraphrase the generalised definitions in Section 3, is about making a new or significantly changed product available to potential users or finding a different way of making it available through the three component processes in Section 3. The question in this section is why the measuring of these activities and the production of indicators is relevant to policy.

5.1. Policy learning

A key issue in any policy process is learning. The OECD Innovation Strategy 2015 makes the point that:

> Policy learning rests on an efficient and well-developed institutional framework, strong capabilities for evaluation and monitoring, applying available good practices, and an efficient and capable government bureaucracy. Incorporating policy monitoring and evaluation at the design stage of policymaking will support evidence-based decision making and accountability and enables policy learning over time, as can experimentation with policy measures at a small scale. Better measurement of innovation outcomes and impacts is essential in this context (OECD 2015b).

Policy starts with an objective of government which either becomes legislation or makes use of existing legislation to provide rules pursuant to the legislation to guide the implementation of the policy. As the OECD quotation suggests, building monitoring and evaluation into the design of the policy makes it easier to provide the evidence that the policy has achieved its objectives, or not, leading to policy learning and change in the policy implementation. For this to happen, there must be measurement, and before there can be measurement of outcomes and impacts, there must be evidence that the target of the policy has actually happened. Then, there can be further measurement to identify outcomes and impacts.

This paper is about the measurement of the activity of innovation in all of the SNA sectors. In order to make this possible a set of generalised definitions, based on those in the Oslo Manual (OECD/Eurostat 2005), drawing upon definitions used in the Public sector by the MEPIN project (Bloch and Bugge 2013), have been proposed (Annex). The generalised definitions can be used in statistical surveys and case study interviews to identify innovation that does, or does not, happen, based on the behaviour of the institutional unit being observed.

The resulting statistics can be used to compare the propensity of innovation in sectors over time, across geography, by industry, by size of the institutional unit, and by other variables of analytical interest. The generalised definitions, to the extent possible, are not normative. They support the identification of the activity of innovation, but not that it is ‘good’ or ‘bad’.

5.2. Restricted innovation and policy objectives

Innovation policies may have an intention to promote inclusive green sustainable innovation and institutional units may be influenced by incentives offered to adopt new or significantly changed processes, or to produce new or significantly changed products to achieve this objective. However outcomes and impacts of the activity of innovation require time to happen. This means that there must be measurement following the first measurement of innovation to identify the outcomes, and later, the impacts. This may require follow-up surveys of institutional units that were innovative to see if carbon emissions had indeed been reduced, that minority groups were included in the activity as employees, users or collaborators and that the innovation allowed the institutional unit to survive, demonstrating that it was sustainable. Social surveys may also be required to demonstrate that the excluded community has, from its perspective, been included as a result of the activity of innovation. Identifying outcomes and longer term impacts, as part of policy monitoring and evaluation is not a simple undertaking that is why the monitoring, evaluation and the supporting measurement should be part of the policy from the beginning. It also demonstrates that the initiator of the policy is conscious of the resulting accountability as well as the opportunity for policy learning.

In Section 2 the concept of restricted innovation was introduced and the example cited and discussed in Gault (2014) was the Mashelkar definition of inclusive innovation.

> Inclusive innovation is any innovation that leads to affordable access of quality goods and services creating livelihood opportunities for the excluded population, primarily at the base of the pyramid and on a long term sustainable basis with a significant outreach (Mashelkar 2012).

This is a good example of a restricted definition of innovation which starts with innovation as defined in the Oslo Manual and then imposes restrictions which require subsequent (social) surveys to confirm that the restrictions have been met.

In Bloch and Bugge (2013) there is a discussion of Mulgan's definition of public sector innovation (Mulgan 2007) which presents a number of restrictions on innovation and raises measurement problems but it provides an illustration of the fact that not all policy issues, as they are being developed, have to be measurable. It is important to present the concepts and to discuss what is important for policy purposes and then to decide how to use measurement to provide an input to monitoring and evaluation before the policy is implemented. The MEPIN definitions (Bloch and Bugge 2013) are closer to those of the Oslo Manual.

In the Household sector von Hippel (2005) has promoted the concept of user innovation where consumers change goods or services for their own benefit or, in the absence of the goods or services that they want on the market, they develop them. This has given rise to many case studies (de Jong and von Hippel 2013) and to a discussion about how to incorporate user innovation by consumers into an Oslo Manual framework. That discussion is found in Gault (2012) and continues in this paper.

For measurement purposes, whatever the SNA sector, whatever the policy imperative, there must be a means of measuring the activity of innovation which requires a definition. Once that is established, a set of restrictions can be added to reflect the policy objectives and then the extent to which the objectives are met over time can be measured. The resulting indicators can be used to monitor the effectiveness of policy interventions and to evaluate the policy, leading to policy learning and the development of new policies.

5.3. Other measurement issues

The purpose of this paper has been to propose a set of generalised definitions of innovation and its components that can be applied, with some discussion on how to implement them, in all sectors of the SNA. The generalised definitions could be implemented through surveys of institutional units in the Business enterprise (Corporations), General government and NPISH sectors and social surveys of households and individuals in the Household sector.

The result of implementing the generalised definitions would be statistics on innovative and innovation active institutional units which could be distributed using variables of relevant analytical interest, such as sources of information for innovation, type of

collaborator for innovation, geography, industry, size (employment or turnover), or engagement in innovation activities such as capital investment in machinery and equipment, software or R&D or in training and other means of knowledge transfer.

To deal with policy objectives there is a discussion on restricted innovation and the implications for measurement (Section 2.3). Not covered is 'social innovation' (Mulgan et al. 2013).

What is also not done in the paper is a review of the innovation system and the role of linkages. For example, a policy to reduce pollution, and the regulations that follow, may result in new production or delivery processes being developed and implemented in public and private institutions. This is an illustration of indirect innovation policy acting through framework conditions established by government as opposed to direct incentives for institutional units to innovate. This is discussed by authors in Gault (2013).

There is an extensive literature on innovation systems[8] consisting of actors engaged in activities, having linkages, and leading to outcomes and longer term impacts. That can be returned to once there is agreement on how to measure the activity of innovation in all SNA sectors.

6. Conclusion

This paper reviews the measurement of innovation, or attempts to measuring innovation in the Business enterprise sector, the Public sector and the Household sector of the System of National Accounts. There is also a short discussion of measuring innovation in the Non-profit Institutions Serving Households (NPISHs). The outcome is a set of generalised definitions of innovation and its components which, in principle, can be applied in every sector of the SNA.

The advantage of having a single framework for measuring innovation in every SNA sector is that policy interventions in different sectors can be compared at the level of the propensity to innovate in the institutional units. Where policy has a number of objectives, and the example used was 'inclusive innovation for sustainable development', additional measurements are required with different time scales to monitor the implementation of the policy, evaluate the outcomes and to learn from the process. Measurement is an intrinsic part of policy learning.

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[8] See Gault (2013, 2010).

based on his work on cognitive testing of innovation survey questionnaires. Students of a course given by the author at UNU-MERIT have raised a number of the questions that are discussed in the paper. Errors remain the responsibility of the author.

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Annex: Generalised definitions of innovation

Innovation

An *innovation* is the implementation of a new or significantly changed product or process. A product is a good or a service. Process includes production or delivery, organisation, or marketing processes.

A new or significantly changed product is *implemented* when it is made available to potential users. New or significantly changed processes are implemented when they are brought into actual use in the operation of the institutional unit.

Product Innovation

A *product innovation* is a product, made available to potential users, that is new or significantly changed with respect to its characteristics or intended uses.

Process Innovation: Three components

A production or delivery innovation is the implementation of a new or significantly changed production or delivery method. This includes significant changes in inputs, infrastructure within the institutional unit, and techniques.

An *organisational innovation* is the implementation of a new or significantly changed organisational method in workplace organisation or external relations of the institutional unit.

A *marketing innovation* is the implementation of a new or significantly changed method of promoting products of the institutional unit.

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